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University of Maine.

Maine Agricultural Experiment Station

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FIELD EXPERIMENTS IN 1914.

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AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

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BULLETIN 236.

FIELD EXPERIMENTS.

Reported by Chas D. Woods.

The work of investigation at the two experimental farms (Aroostook Farm, Presque Isle, and Highmoor Farm, Monmouth) is planned by the Director, the Biologists, the Plant Pathologist and the Entomologist. The results of the more scientific phases of the studies are reported from time to time in the bulletins but it always happens that there are results obtained that lie somewhat outside of the lines of work of any of the Station specialists. Some of the more popular and practical results are here reported. The carrying out of these experiments and the taking of the requisite notes devolved upon different members of the Staff. In general the field work was carried out under the direction of the farm superintendents.

Drawing Conclusions from Field Experiments.

Field experiments at the best are somewhat uncertain because there are so many factors of soil, temperature, rainfall, and the like, that affect the results which are beyond the control of the experimenter. For this reason it is always planned at this Station to carry the same experiment under as nearly as possible the same conditions through a series of years before attempting to draw any very definite conclusions. The results here reported should be considered more in the light of reports of progress than of completed studies. It may happen that the teaching that a single year's results seem to warrant may be reversed by the repetition of the experiment in other years under different climatic or other conditions. This is illustrated in the paper on the Effect of Spraying Iron Sulphate on Potato Tops given on page 51.

Commercial Varieties of Oats at Highmoor Farm in 1914.

The Station has been conducting a test of commercial varieties of oats at Highmoor Farm since 1910. The detailed results of these tests for the four years 1910 to 1913 inclusive were published as Bulletin No. 229. The results of the 1914 test show many interesting points, and are here summarized.

The method used by the Station in recent variety tests has been to plant four plots of each variety. Each plot contains 1-40 of an acre, making in all 1-10 of an acre devoted to each variety. The four plots of a variety are placed in different parts of the field so that the yield of any one variety is less likely to be affected by the quality of the soil. The average of the four plots is taken as the yield of the given variety for the year.

The twenty-one varieties grown in 1913 were again tested in 1914. In addition one new variety was added, viz., the O. A. C. No. 72. This oat was bred at the Ontario Agricultural College and has proven to be a very excellent variety in Canada.

The past season was an exceptionally good one for growing oats at Highmoor Farm. The yields have been far in excess of anything previously obtained. One of these commercial varieties yielded well over 100 bushels per acre. This was the Minnesota No. 26 with a yield of 105.5 bushels per acre. One plot of this variety yielded at the rate of 132.5 bushels per acre. Two other plots reached 100 bushels while the fourth plot gave over 89 bushels.

Three other varieties yielded only a little below 100 bushels per acre. These were the Gold Rain (98.8 bush.), the Early Pearl (98.1 bush.) and the Silver Mine (96.3 bush.).

Of these four highest yielding varieties the Early Pearl and the Minnesota No. 26 ranked second and third in yield in 1913. These two varieties have now been tested for three years. Average yields for the three years are for the Early Pearl, 77.3 bushels; and for the Minnesota No. 26, 75.3 bushels. These two varieties are exceptionally promising for central Maine.

The Gold Rain variety which ranked second in yield this year is also an excellent oat. For the three years in which it has been tested it has averaged 72.6 bushels per acre. This is a yellow oat which was originally bred by the Experiment Station at Svalof, Sweden.

Eleven of the varieties have now been tested for five years. On the basis of the four year tests given in Bulletin 229 the Irish Victor, Imported Scotch, Lincoln and Prosperity were mentioned as the best of these varieties. These four varieties yielded well in 1914 but not so well as some of the newer varieties mentioned above. The 1914 yield of the Irish Victor was 88.6 bushels, the Imported Scotch 86.8 bushels, the Lincoln 87.6 bushels and the Prosperity 88.8 bushels.

The extra early oats like the Kherson, Daubeney and Rebred 60-Day again did not yield as well as the later varieties. It is possible that these early varieties will be better adapted to the northern part of the state than to the region around Highmoor Farm.

On the whole all of the yields were exceptionally high. The average yield of the 22 commercial varieties was 87.5 bushels per acre. The highest average yield obtained in any previous year was 64.2 bushels in 1910. The exceptional yields this year were in the main due to the presence of abundant moisture during the growth and formation of the grain. The grain matured exceptionally well and is of an excellent color. The weight per measured bushel runs unusually high. These oats are exceptionally good for seed and it is hoped that they will be tried extensively by the farmers in the State in 1915.

In addition to the testing of these commercial varieties a number of new varieties have been originated in the breeding work of the Station. A number of these have now been tested in large plots for two years and have given very satisfactory yields. Several of these new varieties are considerably better than any of the commercial varieties so far tested.

The yields per acre of all of the commercial varieties of oats grown at Highmoor Farm in 1914 are shown in the following table:

Yield of Commercial Varieties of Oats Grown at Highmoor Farm in 1914.

Variety	Acre Yield Bush.	Variety	Acre Yield Bush.
Abundance	76	Minnesota No. 26	105
American Clydesdale	77	O. A. C. No. 72	90
Banner	90	President	90
Daubeney	82	Prosperity	89
Early Pearl	98	Rebred 60-Day	81

Garton No. 5	92	Senator	85
Gold Rain	99	Siberian	80
Imported Scotch	87	Silver Mine	96
Irish Victor	89	Swedish Select	83
Lincoln	88	Victor (black)	79
Kherson	78	White Plume	91

Tests of New Varieties of Oats Originated at Highmoor Farm.

In addition to the testing of commercial varieties of oats the Station has been engaged for several years in breeding new varieties of oats that it is hoped will be better adapted to the conditions in this State than any of the existing varieties. The first part of this work was begun in 1910 and has now reached a stage where the results may be given to the public.

In 1910 about 350 individual plants were selected for the variety test plots of that year. In 1911 the seed from each of these plants was sown in a separate garden row. Thus the plants in each row were the offspring of a single plant of the year before. Careful notes were taken on each row, and those which showed the most desirable characters were harvested and threshed, each row by itself. The next year the seed of these most promising rows was planted in small plots of 1-2000 acre. This was necessary on account of the small amount of seed. Notes were again made and only the best plots selected. Thus out of 350 plants originally selected the offspring of 33 were regarded as good enough to continue into 1-40 acre plots in 1913.

In 1914, 31 of these "pure lines" were tested for the second time in duplicate plots. These "pure lines" as they are called are essentially new varieties. Each one of them has been developed from a single plant. Since the oat flower is always self-pollinated each plant in one of these pure lines has the same hereditary constitution as every other plant in that line. For this reason plots of these pure lines are much more even in ripening, in yield, in strength of the straw, and other characters, than ordinary commercial varieties. Further, many of these new varieties are proving superior in yield to any of the commercial varieties so far tested. Out of the 31 pure lines tested for two years 15 have been judged good enough to be offered to the public. These pure lines will be tested further for several years and possibly some more of them will be discarded as showing no substantial improvement over commercial varieties already in existence.

We believe that these pure lines represent better seed than can be obtained in commercial varieties. They are strictly pure bred and come true to type without showing any mixture. They further ripen very evenly which is a very desirable character. With varieties which do not ripen evenly a considerable amount of grain is lost from the shattering of over-ripe plants.

These new varieties have not been given names but bear the number by which they are known in our records, prefixed by the word "Maine." The following table shows the yield of these pure lines for the two years and for 1914. The year 1914 was an exceptionally good one for oats and the yields are higher than can be expected in a series of years. A very limited amount of seed is available from some of these lines.

Yields in Bushels per Acre of the Pure Lines of Oats Bred at Highmoor Farm.

PURE LINE.	2-year average.	1914 yield.
	Bushels.	Bushels.
Maine No. 340	91.4	108.7
Maine No. 337	89.4	120.0
Maine No. 336	88.5	101.7
Maine No. 230	86.8	104.2
Maine No. 351	85.1	100.2
Maine No. 286	83.6	96.7
Maine No. 281	83.2	93.3
Maine No. 247	83.2	103.7
Maine No. 355	81.9	92.7
Maine No. 357	81.5	81.5
Maine No. 307	81.4	95.9
Maine No. 346	81.2	90.6
Maine No. 264	80.4	95.7
Maine No. 128	79.8	89.5
Maine No. 334	79.5	98.9
Average	83.7 Bushels.	98.2 Bushels.

RATE OF SEEDING OATS IN AROOSTOOK COUNTY.

It is the prevailing custom in Aroostook County to seed very heavily with oats. Perhaps the majority of the farmers sow from four to six bushels to the acre. It has been the experience in other parts of the country, and even in other parts of the State, that this is too much seed for the best results. From two to three bushels per acre has given the best results in the southern part of the State. However, knowing that Aroostook conditions are quite different from those in the other parts of the State the Station has not thought it best to make any recommendation for the former region.

The acquisition of Aroostook Farm opened to the Station the opportunity to start experiments in this direction. Preliminary experiments were carried out this year (1914). It must be understood, however, that these experiments must be repeated several years before trustworthy results can be secured. That is, the results obtained this year may not hold good another year when the seasonal conditions are different. What we want to know is—How much oats should be sown per acre to obtain the best yield in a series of years? Consequently too much reliance must not be put in the results of any single year.

Six different rates of seeding were used this year, ranging from two bushels to five. Six plots of the same size were laid out in as uniform a piece of ground as could be found. It is to be remembered that this is the first year the Station has had the farm and little is known of the former management of any of the land. This piece was in potatoes in 1913. Of the treatment and the yield in that and preceding years there is no record. The plots were all of the same size but were less than an acre each. The seeding was done with a large disk drill. The seed used was the Prosperity variety and was grown at Highmoor Farm in 1913. It was planned to run these plots in duplicate but owing to the lateness of the season before the seeding could be done this had to be abandoned.

The following table gives the results for the year 1914.

RATE OF SEEDING IN PECKS.	Pounds of straw per plot.	Bushels of grain per plot.
8	2464	48*
10	2403	50*
12	2916	65
14	2768	58
16	2758	70
20	2600	68

*These two plots were slightly injured by colts which broke through a neighboring fence.

These results undoubtedly indicate that the higher rates of seeding gave better results this year. The first two plots were slightly injured a short time before harvest. On this account the yields were doubtless somewhat higher than found. It is further seen that three bushels per acre have given very nearly as good a yield as five bushels. Why the yield of grain from the plot with 14 pecks of seed should be so much lower than those on either side of it is not clear. Apparently it was not due to the rate of seeding. The yield of straw was as high as on most of the other plots.

It is planned to continue these experiments for several years. In this way it is hoped to be able to answer the question as to the proper amount of seed for Aroostook conditions.

SULPHATE OF AMMONIA COMPARED WITH NITRATE OF SODA AS A SOURCE OF NITROGEN IN POTATO FERTILIZERS AT AROOSTOOK FARM IN 1914.

A few years ago there was quite a general failure of the crop of potatoes in Aroostook County where a certain brand of fertilizer was used. This fertilizer was analyzed by the Station chemists and found to be high grade. While it was not quite up to its guaranty in some particulars it did carry enough nitrogen, potash and phosphoric acid to more than grow a good crop of potatoes. This fertilizer carried none of its nitrogen in the form of nitrate of soda, but it was all in the form of sulphate of ammonia and high grade organic materials. This led to the stronger reaffirming of the position which the Station had taken relative to the use of nitrate nitrogen on the potato crop. In earlier publications it has been pointed out that the potato makes its demands for nitrogen early in the season and that in the cold, late springs so common in Aroostook County, the crop demands that part of the nitrogen should be immediately available. For this reason the Station has strongly urged that about one-third of the nitrogen in a potato fertilizer be nitrate nitrogen.

In the process of making gas and coke from coal there is developed a large amount of sulphate of ammonia, which in many coke and gas plants is still going to waste. In some plants this now is being conserved and many thousand tons of sulphate of ammonia are thus obtained each year. With the increasing use of high grade organic nitrogen for food of animals, the price of tankage has been going higher and higher year by year. It is, of course, desirable, if it can be done, that as much as possible of this sulphate of ammonia which is a comparatively cheap source of nitrogen be used in Maine fertilizers. Because of this, arrangements were made to begin in 1914 a series of experiments to run over a period of several years. The "base" which was used in these goods was made by the wet process, whereby nitrogen from rather low grade goods is made as available as from high grade goods. The available phosphoric acid was furnished in the form of acid phosphate and the potash in the form of sulphate of potassium. The fertilizer was free from chlorides so as to preclude the possibility of the formation of poisonous ammonium chloride. The base carried approximately one-third of the nitrogen that went into the formula. The remainder of the nitrogen was furnished in the form of nitrate of soda and sulphate of ammonia, as indicated in the following plan:

Plot 1. Basal mixture and 2-3 of the nitrogen in form of nitrate of soda.

Plot 2. Basal mixture and 2-3 of the nitrogen in form of sulphate of ammonia.

Plot 3. Basal mixture and 1-3 of the nitrogen in form of nitrate of soda and 1-3 in form of sulphate of ammonia.

Plot 4. Basal mixture, and 1-3 of the nitrogen in form of high grade organic and 1-3 in form of nitrate of soda.

Plot 5. Basal mixture and 1-3 of the nitrogen in form of high grade organic and 1-3 in the form of sulphate of ammonia.

There was about an acre in each plot. The Lowell Strain Green Mountain potato was used for seed. The fertilizer was applied at the rate of 1500 pounds per acre, and supplied about 60 pounds of nitrogen, 120 pounds of available phosphoric acid and 105 pounds of water soluble potash per acre. Other than the fertilizer used the plots were planted, cultivated, sprayed and cared for in all particulars alike.

May and June were rather cool months and hence would be favorable to the nitrate of soda. The mean temperature for May was 53.2 degrees, for June 56.0 degrees, July 63.5 degrees, August 60.1 degrees and September 55.8 degrees. There were several cold nights with frosts in June. May 4 the thermometer went to 25 degrees, May 5 to 32 degrees, June 9 to 30 degrees and June 28 to 31 degrees, and on this latter date there was quite a heavy frost so that it injured potatoes, not in these experiments but on some other plots at Aroostook Farm. The lowest temperature in July was 40 The lowest temperature in

August was on the 28th when it was 35 degrees. It was, however, colder than this at some of the lower parts of Aroostook Farm, where there was a slight frost on this night of August 28.

It is to be remembered that experiments of this kind cannot be expected to give results in a single year that will be conclusive. The weighed yields on the plots were as follows: Plot 1, 127 barrels; Plot 2, 121 barrels; Plot 3, 123 barrels; Plot 4, 126 barrels; Plot 5, 118 barrels, per acre. The plots containing sulphate of ammonia averaged 119 barrels and the plots containing nitrate of soda averaged 126 barrels per acre, while the plot which contained both sulphate of ammonia and nitrate of soda was half way between or 123 barrels per acre. In this single year's trial the results were in favor of nitrate of soda.

It is planned to repeat this experiment in 1915.

METHOD OF APPLICATION OF FERTILIZER UPON POTATOES AT AROOSTOOK FARM.

It has always been more or less customary in growing potatoes in Maine to apply the fertilizer in the drill or hill at the time of planting. This was largely the practice when farm manures were used in connection with potato growing and has been followed with commercial fertilizers. Although now when farm manures are used in connection with potatoes they are more likely to be applied broadcast and a smaller amount of fertilizer applied in the drill. There was little question in the minds of practical growers that when 500 to 1000 pounds of fertilizer were applied per acre that it was to the best advantage to apply it in the drill. With the increase up to 1500 to 2000 pounds per acre the question has arisen whether it may not be advisable to apply the fertilizer at different times. This led the Station to undertake trials at Aroostook Farm.

In 1914 an experiment was started to extend over a period of years for the purpose of testing the method of applying fertilizer. Something over acre plots were used. In the first and fourth of the six plots 1000 pounds per acre of the fertilizer were applied broadcast before planting and 500 pounds were applied with the planter. On plots 2 and 5 the whole 1500 pounds per acre of fertilizer were applied at the time of planting. On plots 3 and 6, 1000 pounds per acre were applied with the planter at the time of planting and 500 pounds at the first cultivation.

The fertilizer used was high grade, carrying 4 per cent nitrogen, 8 per cent of available phosphoric acid and 7 per cent of water soluble potash. One-third of the nitrogen was in the form of nitrate of soda, and the remainder was high grade organic nitrogen. The yields are based upon weighings and not upon measure. The potatoes were clean, without adhering soil.

In potato experiments at Highmoor Farm the Station had found that when there was only a small amount of rainfall following the second application of fertilizer that apparently this added fertilizer was not well utilized. This present season, however, at Aroostook Farm there was ample water to dissolve and render this plant food in all of the fertilizer available. It has been estimated that it takes about six inches of water to successfully grow a crop of potatoes. In the spring of 1914 the ground was well filled with water. In May at Aroostook Farm there was 2.74 inches of rainfall, and in June 4.8 inches, in July 2.23 inches and in August 2.35 inches, or a little more than 12 inches during these four months.

On plots 1 and 4 on which 1000 pounds of the fertilizer were applied broadcast and 500 pounds with the planter at the time of planting, the yield was 121 and 127 barrels, making an average of 124 barrels per acre. On plots 2 and 5, where 1500 pounds of fertilizer were applied all in the drill at the time of planting, the yields were 134 and 127 barrels, or an average of 130 barrels for the two plots. The yields on plots 3 and 6, where the fertilizer was applied 1000 pounds in the drill and 500 pounds with the first cultivation, were the same as in plots 1 and 4, being 127 and 121 barrels with an average of 124 barrels per acre.

In field experiments of this kind even if there had been marked differences it would not do to draw conclusions from a single year's trial because there are so many things that come in to modify the results of a field experiment even when the plots are as large as these were.

So far as a single year's test goes there is little to choose between the three methods, although 6 barrels more per acre were obtained where all of the fertilizer was applied in the drill than in the two other methods. It is interesting to note, however, that one of the plots in each method of treatment yielded at the rate of 127 barrels to the acre. If those plots alone were selected there would have been no difference in yields in the experiment.

It is planned to repeat this experiment in 1915, at which time there will be added another plot in which all of the fertilizer will be applied broadcast before planting and none applied with the planter.

THE EFFECT OF SPRAYING IRON SULPHATE ON POTATO TOPS.

For a number of years the Station experimented with copper sulphate and iron sulphate as a means of eradicating wild mustard from oats. As it was found that wild mustard could be successfully controlled in this way, numerous inquiries were received relative to the possibility of exterminating wild mustard in potatoes. While it was expected that the application of the iron sulphate would materially injure the potato vines there was no experimental evidence as to what the effect would be on the resulting crop.

In 1913 an experiment of this kind was conducted at Highmoor Farm in which, strange to say, there seemed to be an increased yield where the iron sulphate was used. The results were published in Bulletin 224. It was stated as a conclusion: "The experience indicates that with a field of potatoes badly infested with mustard spraying with sulphate of iron solution may be resorted to with a reasonable expectation that the yield of tubers will not be diminished. At present such a treatment can only be recommended as a rather extreme measure."

This experiment, on which the above was based, was conducted in the central western part of the State on Highmoor Farm, and in a year in which there was a particularly long growing season. A similar experiment was made on Aroostook Farm the present season with Green Mountain potatoes. There were five plots, three of which were untreated, one of which was sprayed once with sulphate of iron, and another which was sprayed twice with sulphate of iron. The tops that were sprayed once quite quickly rallied, and those that were sprayed twice were much more checked. The yield per acre on the unsprayed plot was at the rate of 138 barrels per acre. The plot sprayed once yielded at the rate of 111 barrels per acre, and that which was sprayed twice at the rate of 100 barrels per acre.

The results obtained in 1914 were what would naturally be expected and were quite different from those obtained at Highmoor Farm in 1913. This would seem to indicate, as one would expect to be the case, that sulphate of iron applied to potato vines is sufficiently injurious to the vines to render it an impracticable method of fighting wild mustard.

Fertilizer Experiments on Apple Trees at Highmoor Farm.

As it is pretty generally known, when the State purchased Highmoor Farm it had something over 3500 apple trees upon it. These trees were about twenty-five years old, but for the most part had been completely neglected, as regards pruning, fertilization, culture and spraying. The first season that the Station had the farm the orchards were plowed, cultivated and sprayed. Pruning was begun and has been continued until at the present time the orchards are in pretty fair shape. It was, of course, not desirable or practical to thin the trees out at the start to where they should be at the end, but the pruning while rather severe each year has been gradually decreased in amount.

The orchards were annually fertilized at the rate of 1000 pounds per acre of a commercial fertilizer carrying 4 per cent of nitrogen, 8 per cent of available phosphoric acid and 7 per cent potash. At the end of the third year the orchards had so far responded that they gave a good crop and since that time fertilizer experiments have been carried on in various portions of the orchards, as follows:

The use of highly nitrogenous fertilizers have been advocated as a means of forcing trees into bearing and in some parts of the State has been tried with results that seemed to be gratifying. This method was first suggested by Doctor Fisher of Massachusetts and was tried by the Station several years ago in coöperative work with Mr. Pope in his orchard at Manchester without very decisive results. At Highmoor Farm a row of 32 Baldwin trees was divided into three sections. The trees were treated alike so far as the application of standard fertilizer was concerned, but ten of the trees at each end of the row received in addition nitrate of soda at the rate of 100 pounds per acre. Also the Baldwin orchard was divided into two parts so that part of it received the usual treatment and in addition received 100 pounds of nitrate of soda per acre per year. No differences that could be attributed to the additional nitrate of soda have been observed.

In experiments carried out at the New York State Experiment Station it has been found that with their deep clay soils, well suited to apple tree growth and apple bearing, that there is no effect from the use of fertilizers either upon the growth of young trees, the wood growth on matured trees, or in the amount, coloring, or size of the fruit. To see if anything like this would hold with Maine conditions, particularly with the rather shallow soil and with the stubborn subsoil upon Highmoor Farm, an experiment was begun in 1912. It is to be remembered that the orchard had been cultivated and fertilized for the three preceding years and brought into good condition. About 400 trees were divided into three plots containing 12 rows extending clear across the large No. 1, Ben Davis orchard. Plot A, (rows 1 to 4) has received no fertilizer since 1912. Plot B, (rows 5 to 8) has received annually since 1912, 500 pounds of a fertilizer carrying 4 per cent of nitrogen, 8 per cent of available phosphoric acid, and 7 per cent of potash. Plot C, (rows 9 to 12) has received annually since 1912, 1000 pounds per acre of a commercial fertilizer carrying 4 per cent of nitrogen, 8 per cent of available phosphoric acid and 7 per cent of potash.

Careful records of growth shown by measure, and of yields of fruits as shown by weight, are made of all of the trees in the orchards at Highmoor Farm. Thus far no results that could be attributed to the fertilizer have appeared. No person examining the twelve rows of apple trees, part of which have been fully fertilized, part partially fertilized and part not fertilized at all for the past three years, could detect differences whereby he would be able to pick out the treated from the untreated rows.

It is to be remembered that in all of these experiments nothing has been grown upon the land except apple trees and apples. An orchard cover crop is sown in the fall, is plowed under early in the spring, and the land is kept cultivated until well into August when the cover crop is again sown. The plant food stored up in the wood growth and that which has been removed in the apple crop has been taken from the soil, but beyond that the soil has not been made to pay tribute to any other crop.

This experiment is to be continued for many years, or until the unfertilized rows show evidence of need of plant food.

TURNIPS AS A STOCK FOOD.

YIELDS AND FOOD VALUE.

It is probably true that the corn plant generally yields a larger amount of digestible dry matter at less cost than any other plant that usually enters into a rotation. There are, however, parts of the State in which corn does not do well. Even in the corn growing section of the State there are occasional farmers who desire to grow succulent food and do not wish to go to the expense of putting up a silo. These people have always looked towards roots for a green winter food. This is particularly true of the eastern part of Washington County where many farmers are interested, in a small way, in dairying. One of their most serious problems is how to provide some form of succulent food for winter use. On many of the farms corn cannot be grown, partly because of the climatic and partly because of soil conditions. Nor have mangolds been grown in that locality with marked success. Both turnips and rutabagas, however, seem particularly adapted to that section of the State. Large crops can be grown. They thrive on clay soils. They can be planted late after the low lands have become fit to work. They furnish a hoed crop for the rotation upon land on which no other hoed crop can be grown. And they fill a very important place in the ration of the dairy animal.

A coöperative field experiment planned by the College of Agriculture and carried out by Mr. Clarence A. Day on the farm of Mr. F. P. Washburn of Perry, is here reported.

This experiment is in a series in which the following problems are being studied: the place of turnips in the rotation; as to whether the crop does better on sod or on potato ground; methods of fertilization; tests of varieties; and an attempt, if possible, to get at the cause of the serious trouble to turnips in Washington County known as black-heart.

The field selected for this experiment was a clay loam, free from rock, and typical of the better grade clay soils in the towns near the St. Croix River. For the purpose of the test the field was divided into tenth acre plots, 2 rods by 8 rods in size. The fertilizer used, the yields in pounds per plot and in bushels and tons per acre, and the quality of the turnips are given in the table which follows:

Table showing varieties grown, fertilizers used and yield and quality of rutabagas grown in coöperative test at the farm of F. P. Washburn, Perry, in 1914.

Plot.	Variety.	Fertilizers.	Yield.			Quality.		
			Pounds per plot.	Per Acre.		Good.	Black hearted.	
				Bushels.	Tons.		Badly.	Slightly.
						%	%	%
1	Carter's Imperial	600 pounds fish chum	4775	795	23.8	–	100	–
2	Carter's Imperial	400 pounds chum 100 pounds acid rock 30 pounds muriate	5635	940	28.2	45	55	–
3	Carter's Imperial	8 pounds nitrate 80 pounds acid rock 45 pounds tankage 30 pounds muriate	4750	795	23.8	35	65	–
4	Carter's Imperial	15 pounds nitrate 25 pounds acid rock 68 pounds tankage 21 pounds muriate	4485	748	22.4	44	48	8
5	Carter's Imperial	3 loads barn dressing in drill	4805	800	24.0	66	26	8
6	Carter's Imperial	2 loads dressing harrowed in 4 pounds nitrate 65 pounds acid rock 20 pounds tankage 21 pounds muriate	4890	815	24.5	70	16	14
7	Carter's Imperial	2 loads dressing ploughed in 150 pounds acid rock in drill	4025	670	20.1	72	18	10
8	Carter's Imperial	2 loads dressing plowed in 5 pounds nitrate 65 pounds acid rock 20 pounds tankage 20 pounds muriate	4775	795	23.8	66	24	10
9	Skiwings Purple Top	Same as plots 8 and 10	4100	682	20.5	88	0	12
10	Golden Neckless	Same as plots 8 and 9	1900	632	19.0	100	–	–
	White Egg		2835	945	28.3	–	100	–
	Total for the acre		46975	782	23.5			

The average yield per acre for all of the plots and varieties was 782 bushels. The estimated cost of labor, fertilizer, rent of land and seed, was $59.05. At this rate the turnips cost 7.6 cents per bushel, or about $2.50 per ton.

At Highmoor Farm the Imperial Swede rutabagas were grown in 1914 to be used as winter food for sheep. The land was the rather heavy loam characteristic of the farm. It was fertilized with 5 cords of stable manure and 500 pounds of a 4-8-7 fertilizer per acre. The yield was less than that on the

Washington County Farm, being 630 bushels per acre, or 18.9 tons. It required 130 man hours and 45 horse hours per acre to grow and harvest these turnips.

Rutabaga turnips carry about 11 per cent of dry matter. Corn silage from thoroughly matured field corn will have nearly 19 per cent of dry matter, and silage from immature corn carries about 14 per cent dry matter. There have not been many digestion experiments made with rutabagas, but those that have been made show that rutabagas are considerably more digestible than silage made from the entire corn plant. Corn silage has about 70 per cent of its organic matter digestible and rutabagas have 91 per cent. About 55 per cent of the protein of corn silage is digestible while 80 per cent of the protein or rutabagas is digestible. Less than 75 per cent of the nitrogen-free extract (the soluble carbohydrates) of corn silage is digested while 95 per cent of the nitrogen-free extract of turnips is digested.

In the experiments carried on by the Maine Experiment Station it has been found as a result of seven trials that with Maine matured field corn there was an average yield of 11 tons per acre. This carried 4225 pounds of total dry matter of which 3075 pounds were digestible. With the much larger immature Southern corn grown in comparison, as a result of seven trials, the yields were 17 tons of silage per acre. This carried 5000 pounds of dry matter and 3250 pounds of digestible dry matter. Approximately 19 tons per acre of rutabagas grown at Highmoor Farm in 1914 carried about 4200 pounds of dry matter of which more than 3800 pounds were digestible, or considerably in excess of the digestible dry matter produced per acre in an average crop of silage corn. The 23½ tons of rutabagas grown at Mr. Washburn's farm in Perry carried two tons and a half of digestible dry matter or about a ton more per acre than was carried in the mature Maine field corn as found as the result of seven trials by this Station.

As stated at the beginning a ton of digestible dry matter can probably be grown cheaper per ton as corn than in the form of roots. The corn crop can be handled more completely by machinery and has many other advantages. But to the man who has late land, or to one who needs succulent food and has not a silo, or to one in a locality where corn does not thrive well, rutabagas furnish a large amount of succulent matter that can be cheaply grown and without an undue amount of hand labor.

"BLACK HEARTED" TURNIPS.

A very serious drawback to turnip culture in the southeastern part of Washington County is that under certain conditions they are "black hearted." This renders the turnip unfit for market, although apparently it does not affect its value as a stock food. So serious is the situation that some commission men in Boston and New York decline to handle "St. Andrews" turnips at all.

The County Demonstrator for the College of Agriculture in Washington County learned of these facts in 1913, and had specimens sent to the Maine Agricultural Experiment Station by Mr. Washburn of Perry. Mr. Washburn said that these particular turnips were grown upon a fertilizer composed of a ton of smoked herring skins, 400 pounds of bone black, and 300 pounds of muriate of potash per acre. Also that the weather conditions were too dry for the best results during June, July and August. He noted that the disease apparently attacked the turnips as soon as they began to form and was very noticeable when they became as large as eggs. He said that it did not increase in storage. Farmers in that vicinity had always grown the Purple Top rutabaga, they had not noticed that weather conditions at time of planting had any effect on the trouble, although many farmers thought it was worse in a dry season. If the turnips stop growing for a time the trouble almost invariably appears. Mr. Washburn thought there was a relation between the kind of fertilizer used and the turnip trouble. With barn manure and fish composted they would get good turnips. He had used fish pomace alone and raised a light crop of turnips but of excellent quality. The addition of bone black and sulphate or muriate of potash increased the amount of black heart. He sometimes had as high as 275 barrels per acre without a bushel of good ones in the lot.

The turnips sent to the Station were of perfect form outside, the skins were bright and smooth. When cut the flesh had large patches of a dull brown color. The discoloration extended out nearly to the skin. The flesh of many of the turnips was stringy. Careful examination by the plant pathologists showed that this black heart is not a disease in the sense that it is either produced by fungi or bacteria. It is apparently a physical condition arising from some factor or factors in the growth of the plants, which laboratory studies failed to disclose.

One of the objects of the demonstration experiment above described was to obtain light upon the nature and cause of black heart. The crops from these plots were all tested for black heart by cutting 100 turnips taken at random from each plot. The results of this examination are given in the three last columns of the table on page 55.

While very little was learned by the season's experience as to the cause of black heart, several theories which have been advanced have been explained. The fact that on some of the plots the turnips were all black hearted while on others they were nearly all perfect, proves that the trouble is not due to seasonal conditions, nor is it due to the seed used. It also bears out the statement of the plant pathologist that this is not a definite disease, for if it were all of the turnips in one row would hardly be perfect while those in the next row would be all black hearted. In the case of two rows growing side by side of different varieties one was all black hearted and the other entirely free from black heart.

The previous observations made by Mr. Washburn that he is "certain it is not the fish that gives the black hearted product" did not hold in 1914, for the plot manured with fish chum alone had all of the turnips black-hearted. It is not due to the chum alone, for the plot without chum (fertilized with tankage, mirate of soda, acid rock and muriate) had 65 per cent of the turnips black hearted. When grown on barn dressing alone 26 per cent were black hearted; when grown on barn dressing with the addition of chemicals 16 to 24 per cent were black hearted, on the three different plots.

Four plots, fertilized alike with stable manure plowed in and an application of nitrate of soda, acid phosphate, tankage and muriate, were planted with different varieties. Three varieties of rutabagas—Carter's Imperial, Skiwing's Purple Top and Golden Neckless—and a true turnip—White Egg—were grown. The Golden Neckless had a smaller yield than the other varieties but was entirely free from black heart. The crop from the Carter's Imperial had 18 per cent black hearted turnips, that from the Skiwing's Purple Top had 24 per cent black-hearted. The White Egg was 100 per cent black hearted.

There is little warrant in drawing very definite conclusions from this trial. It seems fairly clear that there is a difference in strains as to susceptibility to the trouble, for one variety grown was entirely free from black hearted roots. As the trouble has, so far as we can learn, never been reported elsewhere it evidently is not due primarily at any rate to seed and is perhaps somewhat climatic. The addition of stable manure materially reduced the percentage of black heart an all four plots. Stable manure carries many active ferments, bacteria, and fungi. These may be a factor in control. These trials suggest that a crop free from or with low per cent of black hearted roots is more likely to be obtained when farm manure is used. It is hoped to conduct further coöperative studies in 1915.

Are Sheep Profitable in Maine?

AN EXPERIMENT UNDERTAKEN AT HIGHMOOR FARM.

At the spring meeting of the Station Council the following facts were presented by the Director:

As is well known, the sheep industry in Maine, as well as the country over, has greatly diminished. Apparently the sheep industry in Maine reached its maximum in 1880, at which time there were in round numbers 565,000 sheep in the State. In 1890 this number had become reduced to 370,000 and in 1900 to 248,000, in 1910 to 125,000. Between 1910 and 1912 there has been a slight increase as the number of sheep reported by the State assessors, exclusive of lambs, for that year was about 134,000.

Attention was called to the facts:—that at Highmoor Farm there are about 100 acres in pasture at present unutilized; that there is barn room which with very small expense could be made to carry 150 sheep; and that there has never been permanent agriculture without animal husbandry anywhere in the world. The facts brought out in Bulletin 224 relative to the lack of profit in the sale of hay, because of the large amount of fertilizing material removed from the land in a hay crop, were referred to and it was also pointed out that Highmoor Farm now annually sells considerable hay.

Because of these facts the Council authorized the purchase of ordinary grade sheep sufficient to make the foundation for stocking Highmoor Farm, not for the purpose of a definite scientific experiment but to study the question as to whether sheep can or cannot be profitably raised in Maine. For this reason the sheep carried upon the farm are not of fancy type. They are not pure bred and, therefore, none of the animals can be sold at a fancy price. They are just plain sheep such as any ordinary farmer can carry. While care is exercised in handling the sheep no high priced labor is used. No special "shepherd" is employed.

As this experiment is not of sufficient scientific character to warrant its being carried out by any funds which are available to the Experiment Station for work of investigation it is necessary to keep distinct, separate accounts for every item of expense and of receipts. Consequently from the treasurer's books it will be possible at any moment to know whether the sheep are or are not paying.

The experiment was begun by placing upon the farm early in the summer of 1914 a flock of 75 grade Hampshire sheep with their lambs. The sheep were bred in the fall of 1914 to pure Hampshire sires. The whole matter is more of a demonstration experiment than of investigation, and is and will be handled chiefly with the purpose of ascertaining whether or not hay and pasturage can be profitably marketed through sheep. The further question as to how far sheep may be relied upon to maintain fertility upon Maine farms will be considered.

Only ordinary animals with ordinary care under ordinary conditions are being used. If this venture proves to be a profitable one it will be such that any man in the State can imitate if he wishes to do so. If, barring accidents, this venture does not prove to be a financial success it is doubtful if the Maine farmer would be justified in carrying ordinary sheep for ordinary market purposes upon his farm.

The two chief initial items of expense are for the sheep themselves and for the fencing of the pastures. Because of the irregular shape of the pastures at Highmoor Farm in order to enclose and properly divide the 100 acres, it was necessary to build nearly two miles of fence. As there are few sheep kept in the vicinity of Highmoor Farm, and as the laws of the

State permit dogs to run loose, it was thought necessary to make this fence as nearly dog proof as practicable. It is rather fine woven, extra heavy wire fence 58 inches high with a barbed wire on the inside top. Partly because of the difficulty of obtaining sufficient numbers of cedar posts at a reasonable price and partly because of the increased expense of setting wooden posts, steel posts were used. The corner posts were set by boring a hole with a soil auger and driving to the required depth. The cost of the material for the fence was greater than it would have been if wooden posts were used, but the cost for labor in building was less. Steel posts are also more readily driven in the spring if thrown up by frost.

While the first cost of this fence is quite large it is very durable. The fence should last with only slight care to drive down the line posts each spring longer than a stone wall will last. The fence is probably man proof as well as dog proof. If it does not prove the former a second barbed wire will be strung which will effectually stop anyone, even the most athletic, climbing over the fence without practically destroying his clothing and receiving serious injury from barbs. The barbed wire is on the inside of the fence and makes a lawful as well as effective highway fencee.

During the winter the sheep are being fed as follows: At 6 A. M. hay; at 10 A. M. roots (rutabagas) and apple (culls); at 2 P. M. straw with grain prepared as described below, and at 5 P. M. clover hay. They are given only what they will clean up. They are in pretty close feeding quarters which stimulates competition and makes for cleaner and better eating of the feed.

In the rotation that has been carried upon the farm there are quite large amounts of oat straw to be disposed of. There is only a small market, and at poor price, for oat straw. It is used not only in bedding the sheep but is made into a part of the daily ration. The straw is cut into short lengths by passing it through a small ensilage cutter (power driven). To each 12 bushels of the cut and dampened straw there is added a bushel and a half of grain mixture composed of equal parts corn meal, white middlings and linseed meal. The sheep clean up all but the coarsest of the mixture.

PREPARING LAND WITH DYNAMITE.

A great deal has been said about and considerable work has been done with dynamite as a means of loosening soil for crops. A trial was begun at Highmoor Farm in 1912. An acre and a half of land, the soil of which is fairly uniform that was in pasture and apparently had not been in crop for twenty-five or more years, was made free from stone, divided into three uniform plots of a half acre each, and treated as follows in September, 1912: One-half acre (A) was plowed and then sub-soil plowed. Another half acre, the middle one (B), was prepared by boring holes 30 to 36 inches deep a rod apart and discharging one-half pound stick of 20 per cent dynamite in each hole. The third plot (C) was plowed in the usual way. The plan is to leave the whole field to be treated alike each year to see if any difference could be noted in the resulting crops in the three methods of preparation.

The soil is the usual rather moderately heavy loam of Highmoor Farm which is underlain with a very difficultly penetrable sub-soil. In the spring of 1913 the whole field was plowed and the proper seed bed made for the planting of potatoes. The rate of seeding, use of fertilizers, time of planting, frequency of cultivation, and spraying to prevent blight, were all alike on all three of the plots. Careful records were made during growth and at the time of harvest. There were no appreciable differences in the crop on the three different plots. In 1914 the field was in corn. While there was not a uniform stand there were no differences that could be attributed to the method of preparation.

The field will be sown with oats and seeded to grass in 1915, but it is not likely that any differences whatever will appear. Notes will be made during the growing season and the yields will be measured at harvest.

Also in 1913 it was necessary to reset about 150 trees in the Baldwin orchard. Part of these trees were set in the usual way, by digging holes in the spring with a spade, thoroughly mixing the soil and setting out as commonly practiced by orchardists. Scattered over the orchard at varying points that seemed to be uniform and comparable with the others, the soil was loosened by the explosion of sticks of dynamite in the fall of 1912. The trees here were also set in the spring of 1913. There have only been two seasons of growth since these trees have been set, but there are no appreciable differences that can be attributed to the method of preparation of soil. The discharge of a half stick of dynamite at a depth of 30 inches loosened the soil horizontally for a distance of about 20 feet. No very great depth of disturbance could be traced below the level at which the sticks were placed.

Further trial was given in this particular soil to see if it was possible to take care of surplus water that in spring time accumulated in some parts of the Ben Davis orchard No. 1. For this purpose holes were bored in the fall of 1912 to the depth of about eight feet, and three sticks of dynamite discharged. In the spring of 1913 and 1914 there was no appreciable difference in the way in which these places that were treated with dynamite drained than in similar wet places which were not treated with dynamite.

In all of these cases the work was done by an expert in the use of dynamite sent out by one of the powder companies.

So far as the soil and soil conditions on Highmoor Farm are concerned it is doubtful if there is any advantage whatever in the use of dynamite in the preparation of soil.

Rotation Experiment.

POTATOES FOLLOWED BY POTATOES VERSUS CORN, FOLLOWED BY OATS AND GRASS.

There is a more or less widespread opinion that sweet corn is an exhaustive crop and not a good one to precede seeding down. In 1911, at the suggestion of the late Hon. Rutillus Alden, an experiment was begun upon Highmoor Farm to test the exhaustive effects of corn and potatoes in relation to land treated with chemical fertilizers and with organic manure. Four acres were selected in 1911 for the experiment. The whole field was planted to potatoes on chemical fertilizer that year, using 1,600 pounds per acre of a 4-8-7 goods. Green Mountain potatoes were used and the yield was practically uniform over the piece. The different treatments began in 1912. It will be noted that on plots A and B that only commercial fertilizer was used. On plots C and D 8 cords of well rotted farm manure, as well as 600 pounds 4-8-7 commercial fertilizer, were applied to each in 1912. On plots A and D potatoes were grown again in 1912. being a second crop in succession.

The experiment is somewhat unsatisfactory. partly because that in 1912 the yield of potatoes was small, due to the combined attack of Rhizoctonia and early blight. Also sweet corn has never been grown to advantage at Highmoor Farm. As noted, the crop in that year was small. 1912 had a dry summer which doubtless contributed to the reduced yield.

The results are given in the following tabulation. It will be noted that there is no special effect to be attributed to the sweet corn on the after crops, although the yield of sweet corn was materially less on commercial fertilizer than on the farm manure plus commercial fertilizer. The yield of hay in 1914 was greater on the plots that had farm manure in 1912.

Rotation Experiment. Treatment and Yields.
In 1911 Potatoes Grown on all Plots. Good Yields. 1,600 lbs. 4-8-7 Fertilizer Applied to Each Plot.

Year.	Fertilizer Used.	Yields.
	PLOT A.	
1912	1700 lbs. 4-8-7 commercial fertilizer	89 bushels potatoes.
1913	500 lbs. 4-8-7 commercial fertilizer	54 bushels oats. 2225 lbs. straw.
1914	350 lbs. top dressing*	4725 lbs. hay.
	PLOT B.	
1912	1700 lbs. 4-8-7 commercial fertilizer	2808 lbs. sweet corn ears. 3620 lbs. stalks.
1913	500 lbs. 4-8-7 commercial fertilizer	58 bushels oats. 2230 lbs. straw.
1914	350 lbs. top dressing*	4750 lbs. hay.
	PLOT C.	
1912	8 cords farm manure. 600 lbs. 4-8-7 commercial fertilizer	3482 lbs. sweet corn ears 3385 lbs. stalks.
1913	500 lbs. 4-8-7 commercial fertilizer	59 bushels oats. 2475 lbs. straw.
1914	350 lbs. top dressing*	5000 lbs. hay.
	PLOT D.	
1912	8 cords farm manure. 600 lbs. 4-8-7 commercial fertilizer.	87 bushels potatoes.
1913	500 lbs. 4-8-7 commercial fertilizer.	54 bushels oats 2120 lbs. straw.
1914	350 lbs. top dressing*	5065 lbs. hay.

*100 lbs. nitrate of soda, 150 lbs. acid phosphate and 100 lbs. muriate of potash.